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Semi-interpenetrating network composites of poly(lactic acid) with *cis*-9-octadecenylamine modified cellulose-nanofibers from *Areca catechu* husk

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ABSTRACT

Poly(lactic acid)/cellulose-nano fiber (PLA/CNF) composites were prepared with CNF synthesized from the areca husk fibers (AHF) by TEMPO-mediated oxidation for the first time and the properties were evaluated. MCNF synthesized by the controlled amidation of CNF with cis-9-octadecenylamine (OA) resulted in PLA/MCNF composites with higher mechanical properties and tunable elongation compared to PLA/CNF. It was shown that the tensile properties can be further improved with induced cross-linking at melt processing conditions using dibenzoyl peroxide (DBP) in PLA/MCNF/DBP. The increased elongation observed with higher MCNF content showed the possibility for control on brittleness in these transparent nano composites. The higher modulus and thermal stability observed in the cross-linked composites with 2 % MCNF and 2 % DBP attributed to the formation of semi-interpenetrating network (SIPN) by *in situ* cross-linking evidenced by SEM and TEM observations. DSC analysis of cured composites showed lowering of Tg with MCNF incorporation which may be attributed to the increased segmental mobility of PLA due to reduced interface by cross-linking. DMA analysis showed the better compatibility of the MCNF with the PLA matrix in SIPN attributed to the long alkyl chain modification. The increase in modulus with a negative shift in the tan peak position further supported the cross-links in SIPN. These SIPN showed transparency to visible light and a very low water absorption of 1.5 % compared to 7 % for virgin PLA. These green composites with tunable flexibility, modulus and better thermal stability showed prospects for applications as transparent eco-friendly food packaging material.

Keywords: Bionanocomposite, Poly(lactic acid), Natural fiber, Cellulose nanofiber, Semi-interpenetrating Network.

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1. Introduction

Green composites of degradable polymers with natural fibers are important as packaging films concerning the environmental problems associated with commodity plastics which are